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Experiments on the Reflection of Sound from Flames and Heated Gases.

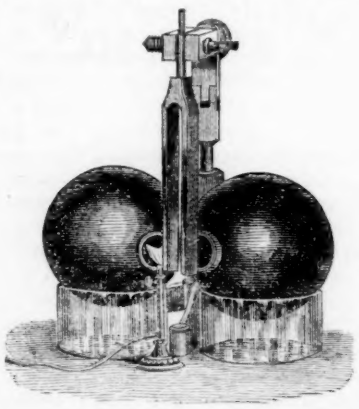
By Alfred M. Mayer.

THESE EXPERIMENTS SHOW THAT FLAMES, HEATED GASES, AND COLD GASES, OF DENSITIES DIFFERING FROM THAT OF THE ATMOSPHERE, CAN REFLECT SONOROUS AERIAL VIBRATIONS; AND THEY HAVE ALSO GIVEN A MEASURE OF THE REFLECTING POWER OF FLAT GAS-FLAMES.

The reading of the interesting research of Professor Tyndall on "Experimental Demonstrations of the Stoppage of Sound, by Partial Reflections in a Non Homogeneous Atmosphere:" (Proc. R. S., Jan., 1874, *Nature*, Jan. 29–Feb. 5), and of the subsequent paper by Mr. Cottrell "On the Division of a Sound-Wave by a Layer of Flame, or Heated Gas, into a reflected and a transmitted Wave," (Proc. R. S., Feb. 12, 1874), caused me to turn my attention to the experimental illustration of the reflection of sonorous vibrations from flames, heated gases, and from sheets of cold gases and vapors.

The following experiments are of easy execution and show in a marked manner the reflecting powers of sheets of flame and heated gas, and even serve to give the approximate measurer of these reflecting powers.

Take two similar resonators* and place the planes of their mouths at a right angle; then in this angle firmly fix the fork corresponding to the resonators, so that the broad face of one of its prongs faces the mouth of one resonator, while the space between the prongs faces the mouth of the other resonator. (See the figure). By trial the two planes of the fork are



* The "Resonator" of Helmholtz, which is so largely employed by Prof. Mayer in his fertile investigations, is simply a hollow globe of thin brass, with an opening; which acts like a sounding-board, in wonderfully exalting the sound, to the ear, of a tuning-fork vibrating opposite the opening. The effect may be rudely illustrated as similar to that of the reverberations in a sea-shell held to the ear. Our readers ought to have indicated to them that the above is the *first* publication of these interesting results of Prof. Mayer.—Ed.

placed at such distances from the resonators that complete interference of the vibrations issuing from their mouths is obtained, and the only sound that reaches the ear is the faint sound given by the fork's action on the air, outside the angle included by the mouths of the resonators. If, in these circumstances, we close the mouth of either resonator with a piece of card-board, the open resonator will strongly reinforce the sound of the fork. If we now cover also the mouth of this resonator with a piece of card-board, we will again have silence. Also, if we substitute for one of the pieces of card-board, a slip of stout glazed note-paper, the same result is obtained. But, if we replace the piece of note-paper by a similar piece of French tracing paper, a faint sound issues from the resonator so covered, because the tracing paper is sufficiently permeable to sonorous vibrations, to permit the resonator to slightly reinforce the sound of the fork. This reinforcement becomes greater if we substitute for the tracing-paper a piece of tissue-paper—such as is used in printed books for covering steel engravings; and a yet greater reinforcement is produced when we put in the place of the tissue-paper, a piece of the soft, loosely-woven paper, which is used by French instrument makers for the inner wrapping of their packed wares. I thus obtained a graded series of substances more and more permeable to sonorous vibrations.

I again obtained neutralization, by interference, with the mouths of the resonators open; and then closed one of them with a bat's-wing coal-gas flame The vibrations issuing from the resonators were no longer neutralized, but the vibration from the uncovered resonator had a great ascendancy over the other, so that a strong sound issued from it. I now tried to destroy this superiority by closing its mouth, successively, with the graded series of paper screens. The loose, soft paper was not equal to it, nor was the tissue-paper; but the tracing-paper just equalled the effect of the gas-flame, in guarding the mouth of the resonator from the entrance of sonorous vibrations.

On lowering the top of the gas-flame so that its top luminous border was just below the mouth of the resonator, and therefore only a sheet of heated air ascended across the latter—the balance of the tissue-paper against the hot gases and vapor remained unimpaired. Thus it appears that the reflecting power of a sheet of coal-gas flame, or of a sheet of the heated carbonic acid and vapor of water just above it, exactly equals, in the above described circumstances, the reflecting power of tracing-paper.

I have also found that the passage of a sheet of cold coal-gas across the mouth of the resonator was sufficient to destroy the balance of the interference, and caused a faint sound to issue from the other resonator; a similar effect, and nearly equal in intensity, was obtained with a sheet of cold carbonic acid gas, while cold dry hydrogen closed the mouth of the resonator more effectively than either of the above gases, but was far inferior in this shielding action to the sheet of heated gases above the bat's-wing gas-flame. I attempted to get a rough measure of the "acoustic capacity" of hydrogen, but could find no substance sufficiently permeable to balance it, except a sheet of rather fine wire gauze.

We should not place too much confidence in measures of the reflecting power of surfaces, made by the method just described, and which I have used merely to give a rough measure of the reflecting powers of the above named gaseous sheets; for the substance which closes the mouth of the resonator may allow a considerable portion of the sonorous vibration to enter the latter, and yet the resonator may not be able to reinforce the sound, by reason of its being thrown out of tune with the fork, by an unyielding surface closing the aperture of the resonator. Thus, a sheet of thick note paper prevents resonance as effectively as a thick piece of Bristol-board, or a plate of metal; yet we know well that these substances have very different powers to reflect sonorous vibrations.

As a flat coal-gas flame equals a piece of tracing-paper in reflecting sonorous vibrations, it follows that we can substitute the former for the latter, in all experiments when the presence of the paper produces, by its reflecting power, an alteration in intensity or in pitch. Thus, if we vibrate a fork before the mouth of a resonator, while the nipple of the latter is open, we obtain a far inferior reinforcement to what takes place when the nipple is closed. Now the nipple can be partly closed with a gas-flame or a sheet of heated air. Thus, alternately closing and opening the nipple of an Ut^4 resonator with the flame of a Bunsen burner, gives excellent results. The reflecting power of a bat's-wing flame is also well-shown, by successively closing and opening the mouth of any resonant box of forks in the octave Ut^4 to Ut^5. Also, if the plug be taken out of the ends of closed organ pipes—and these pipes be placed horizontally—the reflecting effect of the flame is heard when the latter is passed forwards and backwards, across the open ends of the pipes, while the ear is placed in the axis of the pipes. The simplest method, however, is to sound the fork (either continously, by magnetism, or by a bow) in front of its resonator, and successively to close and open the mouth of the latter with a flame, or sheets of heated gas, or of cold vapors, or gases.

The contemplation of these experiments naturally calls up the question:

Is the action of the flame due entirely to reflection? may it not also absorb part of the sonorous vibration, as in the analogous phenomena of the reflection of light?

If the intensity of the sonorous vibrations which

have traversed the flame, equal the intensity of the vibration which impinged on the flame, minus the intensity of those which were reflected from the flame, then there is no absorption of these vibrations by the flame; but if this equality does not exist then there is absorption in the flame; and this means that *the flame is heated by the sonorous vibrations*, which enter the flame as heat vibrations. It thus at first appears that the absorption of the sonorous vibrations might be detected by their production of an increase in the temperature of the flame, just as sonorous vibrations are absorbed by caoutchouc, and reappear in this substance.

In the following manner I have recently made experiments, in the direction of determining the equivalent of a given sonorous aerial vibration, in fraction of a Joule's unit of 772 foot pounds, I stretched between the prongs of an Ut^3 tuning fork, a piece of sheet caoutchouc, 100th of an inch in thickness, and about ½ inch broad. The effect of this rubber on the vibrating fork is rapidly to extinguish its vibrations, with which the rubber itself is heated; and if a fork be vibrated continuously, by one and the same force, when the rubber is stretched on it, and then when it is taken off, the aerial vibrations produced by the fork are far more intense in the latter circumstances than in the former. By a method described by me in the *Am. Jour. Sci.*, Feb., 1871, I now measured the relative intensities of the aerial vibrations, in these two conditions of vibration. The sheet of caoutchouc was now enclosed in a compound thermo-battery, and the fork vibrated during a known interval; the rubber was heated by the vibrations, which would have appeared as sonorous vibrations, if the rubber had been removed from the fork. The amount of heat given to the caoutchouc was accurately determined, by the deflection of a Thomson reflecting galvanometer, connected with the thermo-battery; and, by knowing the interval during which the fork vibrated, the amount of heat given to the caoutchouc during this interval, and the equivalent of the heated rubber in water, I calculated the intensity of the sonorous vibration in terms of a thermal unit, from which I at once obtained the value of the sonorous aerial vibrations, when the fork was not heating the rubber, in other words, when it vibrates freely. I thus found that the sonorous aerial vibrations, during ten seconds, of an Ut^3 fork placed in front of its resonator, equalled about the 100,000th part of a Joule's unit; that is, they can be expressed in the work done in lifting 54 grains one foot high. This quantity of heat, which is equal to the heating of ½ pound of water one 100,000th of a deg. F., expressed the amount by which the gas flame would be heated, if it absorbed all of the sonorous vibrations issuing from the Ut^3 resonator. But this is such a small fraction of the entire heat in the flame, that it is far within the actual fluctuations in temperature in the flame; and even if the flame were constant in temperature, this small increase could not be detected by any known thermometric method. We cannot therefore determine the amount of absorptive power of a flame, or sheet of heated air, for sonorous vibrations, by experiments on their increased temperature, when sonorous vibrations impinge on these bodies.

HOBOKEN, April 10, 1874.

Making a Gas Well Useful.

An abandoned oil well at Leechburg, Pa., from which much gas but no oil has been obtained, is now being utilized and made to yield a profit as large as if its product was petroleum itself. The well was put down some time ago in search of oil, and when at the depth of twelve hundred feet a vein of gas was opened, the flow from which was so great as to prevent further drilling. The well was abandoned, when Mr. Rogers, of the firm of Rogers & Burchfield, conceived the idea of utilizing the rapidly wasting gas in furnishing fuel for their rolling mill. He purchased the well, and fitted up a large iron receiver, where it was freed from the water with which it was impregnated when thrown from the well. From this receiver the gas is conducted a distance of 1000 feet to the rolling mill, through a two-inch pipe. They are burning it under a battery of four large boilers, which produces steam sufficient to run seven pairs of rolls and two large steam hammers. The amount burned in the mill does not amount to one-tenth of the supply furnished by the well; and the firm now propose to lay a larger pipe, and carry the gas to their annealing and sheet furnace. Mr. Rogers expresses the opinion that it produces a better and purer heat than coal, and enables them to produce a larger quantity of iron. By the use of the gas the firm saves the price of 1000 bushels of coal—about $100 per day.—*National Oil Journal.*

Chemical Repertory.

No. 110.—May 2, 1874.

EDITOR—HENRY WURTZ.

CHEMICAL EXCERPTS.

1090. BAD. BAD.—The quarterly report of the Boiler Inspectors shows 528 inspections, during which 108 defective boilers were discovered; 212 engineers were examined, 26 being found incompetent.

1091. TAKING DOWN STOVES.—We have months ago given the experience of the *Danbury News* man on putting up stoves. This being the season for the reverse operation we find that he recommends that in carrying the stove, on the stairs, you should always carry the lower end. Hear him a little: he says "the chief advantage of being below is that, in case of the stove falling, you will be caught beneath it, and instantly killed. Nothing short of your death will ever compensate for the scratched paint, soiled carpet and torn oilcloth. And no man in his senses—and with his hearing unimpaired—would want to survive the catastrophe."

1092. PETROLEUM GAS IN HOBOKEN.—A newspaper item informs us (if true) that preparations are being made in Hoboken to test upon a large scale the Spencer process of manufacturing gas from crude petroleum. The parties are building works capable of producing 300,000 feet of gas per day.—[See editorial page.]

1093. DOCTOR OLLAPOD'S OPINION.—The Sanitary writer of the New York *World* has, we fear, had some trouble about his gas-bill. In a recent article he says:—

"It would be an insult to the intelligence of my readers to make more than a passing allusion to the ammonia, sulphuretted hydrogen, and other villanous vapors emitted from illuminating gas-works, which the companies unanimously opine to be rather conducive to health than otherwise, from which opinion I have the misfortune to differ *toto calo*."

1094. JERSEY CITY GAS ITEM.—The Jersey City Gas Company are erecting a new holder at their works in Sixth street, which will hold, when completed, 220,000 cubic feet of gas. The dimensions will be 86 feet 6 inches in diameter and 21 ft. deep, and it will cost about $50,000. The mason work is done by Hall & Son of that city, and the iron work by Morris & Tasker of Philadelphia.

1095. GASEOUS ACETYLENE. ACTION OF ELECTRICITY.—MM. Thenard found that when acetylene gas was exposed to the action of electric effluvia, it condensed very rapidly, 4 to 5 c.c. in a minute, appearing on the interior surface as a solid body of vitreous or horny look, very hard, and with the color of wine. It is refractory to all solvents, even fuming nitric acid. It gave on analysis the elementary formula of gaseous acetylene.

1096. STREET-GAS KINDLING.—A new method, by Mr. Wilson, for lighting street gas lamps is as follows: "The lamp has two burners: one, very small, burns all the time, When the gas pressure is raised, a small gas holder, on the top of the column, is elevated, affording a passage for the gas to the larger of the two tips, which is lighted by the small jet. Thus all the street lamps in the district may be lit automatically.—*Scientific American.*

1097. QUALITY OF COAL.—Our friend Saward, in his *Coal Trade Journal*, righteously and thusly exhorteth:

"A great many persons appear to think that so long as coal is offered to them at a low rate, this is all that is necessary, and therefore they must be running their manufactory or household cheaply, and to the best advantage. Such people see not beyond their noses; they save at the tap got, but lose at the bung-hole. The price should really be a secondary matter. Quality should be the main consideration, and if the price of a superior quality of any description of merchandise is higher, you may be sure that it is the cheaper article in the end. "Cheap coal," in the popular acceptation of the term, is a great nuisance and a misnomer."

1098. HEATING APPARATUS, FOR DOMESTIC PURPOSES.—A new form of heating apparatus, intended to warm comparatively small quantities of water at a time has recently been patented by Mr. Strode. A vertical chimney is arranged over a set of Bunsen burners. This chimney consists of an inner and outer cylinder, and in the jacket thus formed a current of water is allowed to flow, taking up the heat as it goes from the heated surface of the inner cylinder. The water is admitted cold at the bottom, and discharged at the top heated. The invention is intended for use in positions where a complete heating apparatus for hot water supply with cisterns, etc., cannot be constructed.—*Jour. Soc. Arts.*

1099. PULMONIC CANDLES.—Under this name, Field & Co., the great English chandlers, have introduced candles containing in their substance some of the gum-resins and balsams, especially benzoin and storax, which from time immemorial have proved useful in chronic bronchitis, and allied maladies. When burnt, the candles yield, by the combustion of these drugs, a pleasing fragrance, and at the same time give a good light. Candles are not much used in this country, but we should not be surprised if some enterprising Yankee adapted the idea to the medication of kerosene; which may thus be compelled to make partial amends for the slaughter it has caused. The aromatic odor alone would be an improvement of the unfragrant combustibles.—*Min. and Sci. Press.*

1100. *Iron*, ABOUT A GAS WELL.—The variety of *Homo sapiens* known as "Dogberry" does not seem to be confined to the English soil, or else takes quickly to the land of his adoption. On the Dougan farm, United States, there is a gas-well, which the proprietors have tapped and coaxed into a main laid down to the skirts of Parker city. This portion of the plan for supplying the city seems to have been completed before application was made to magnates of the borough, and they, considering that the gas company had been wanting in due respect to their high mightinesses, refused almost *en masse* to allow the gas to be brought into the town, preferring to leave their benighted fellow citizens in utter darkness at night, and in want of cheap warmth by day, while the gas blazed away like two large burning trees day and night by the hillside, to which it had been conveyed. We should not care to be in that town as a peaceable inhabitant by night or a dishonorable councillor by day.

1101. PSAISEWORTHY ENTERPRISE.—The London *Gas Journal* says that it has "repeatedly urged on gas companies the advisability of their taking greater interest in their consumers fittings (unfortunately they have no control over them); as a means of preventing a majority of the complaints that are made of bad gas, want of pressure, etc. It publishes a letter from Mr. Marks, secretary of the Sheppy Gas Company, showing excellent results his company have obtained by hiring out fittings to small consumers. The profit obtained by the company has been very considerable, and the blessing of a gaslight, which involves no trouble and next to no risk, at the cost of one penny per burner per night, must be fully appreciated by the intelligent poorer classes. The plan adopted at Sheerness would largely increase the consumption of gas in most country places, and in London also. It hopes the company will go a step farther, and let, on hire, small gas cooking apparatuses, which would be a great boon in the summer season."

1102. WARMING STREET CARS.—The *National Car Builder* gives the following description of an apparatus for the above purpose:

"An apparatus for warming street cars is now being introduced on some of our city lines, by Mr. John

Whiteford, of Chicago. It consists of a small furnace placed under the car and attached to the centre of the flooring. The fuel is deodorized coal oil, supplied from a reservoir under the hood, or just above the driver's head. The furnace is inclosed in a casing of galvanized iron, forming an air-chamber, from which the warmed air is admitted into the car through a register some three feet long, extending lengthwise in the centre of the passage-way. The supply of oil is regulated by cocks to suit the temperature. The apparatus is simple and inexpensive, and the consumption of oil does not exceed a gallon or a gallon and a half in twenty-four hours. It is now being tried on the Third and Fourth Avenue, and the Harlem and Morrisania lines.

1103. New-Orleans Ice Manufacture.—The manufacture of ice at the South is progressing rapidly, several different processes having been adopted. The pioneer was the New Orleans factory, which a foreign visitor two years since described as "the sweetest, cleanest, most scientific, artistic, and beautiful of all factories ever seen or imagined, where seventy-two tons a day of ice are manufactured from distilled Mississippi water by fire and steam power, through Carre's apparatus, the volatilization of liquefied ammoniacal gas being the refrigerator." This company, with half a million dollars capital, immediately reduced ice from $40 to $15 per ton, dividing 25 per cent. profits, to the dismay of the "hewers of ice and coolers of water" North, who had until that time enjoyed a monopoly. Now, in Columbus and elsewhere, other inventions have been tried, and small machines, fitted for farm or household, are made at moderate cost. Some of the ice thus produced is equal to the Northern lake article.—De Leon, *Harper's Monthly*.

1104. Castor Oil for Leather.—A correspondent of the Germantown *Telegraph*, who says he has tested all the patented preparations and popular recipes for preserving leather, prefers castor oil to all of them. He adds: "We have had boots a year old that we have oiled with it, and the leather was soft, smooth, and water proof to the last time they were used. We apply it, clear, without heat. A little lampblack might be used on old leather, but it is seldom necessary on new, as the oil itself, seems to keep the blacking on, and renders the leather black and of fine appearance. Those who have been annoyed with hard, cracked, water soaked boots, the surface of the latter, rough, without blacking, and the leather shrunken and wrinkled, so as to chafe, gall, and otherwise punish the feet, will find castor oil, well applied, to be satisfactory. We have used it for wagons and buggies, and find it is in every way superior. It will wear longer, lubricate better, and is less objectionable than anything we know of."

1105. The Dry-Scrubber Controversy.—In an editorial of Jan. 2, we referred—as well as in previous issues; to this dispute about priority, into which some of our American inventors might justly enter. In reply to M. Colladon of Geneva, Pelouze and Audouin state that their novelty is the reflecting condensation in the dry state, by simple shock of finely divided liquefiable matters, without the intervention of water, or of any liquid solutions, and without cooling surfaces, both of which, as they assert, M. Colladon employs. About the principle of using *dry* surfaces, there is no question in the American cases we have referred to. It would appear that still another claimant, one M Alleau, has arisen in France. What a pity that the question of value or utility of an invention could not be always settled first of all, before so much ink, intellect and indignation are shed upon the point of priority.

1106. Source of Error in Thermometers.—M. Morgan, Student in the laboratory of Owens College. Communicated to the Manchester Philosophical Society.

While engaged in distillation, a fact has come under my observation which, although it has been noticed before, does not appear to be very generally known, and has not, so far as I have seen, been recorded.

The thermometer, which was placed in a Wurtz tube so that the column of mercury was entirely surrounded by the vapor of the distilling liquid, was found after some days to indicate 3° too little—a discrepancy caused by volatilisation from the surface of the column of mercury and condensation on the upper part of the tube. By causing the mercury to flow to the end of the tube and back, the condensed portion was gathered up, and the correct temperature indicated. It has since been observed that after each day of distillation, with liquids boiling between 60° and 100° C., a quantity of mercury equal to 1° or 1·5° volatilises, and that this quantity is scarcely perceptible when condensed on the surface of the bore. The thermometer in use was about the ordinary size, with a scale of 360°.

I am informed that Geissler sometimes encloses a little hydrogen in his thermometers, in order that volatilisation may not go on so rapidly.

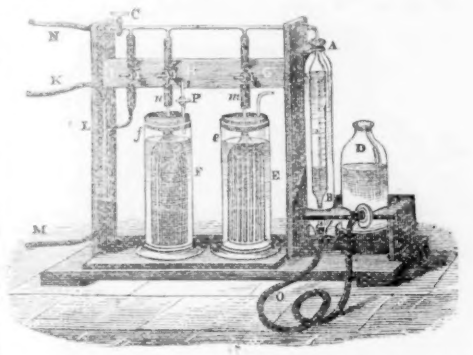
Orsat's Apparatus for Analysis of Gaseous Products of Combustion.

There are few subjects in connection with the manufacture of iron that are of greater importance than the reactions that characterise the process of smelting in its various stages. A precise knowledge of the proportions of carbonic oxide and carbonic acid, given off at different times during the operation of combustion in a furnace, may be regarded as not only desirable, but essential to success in the attainment of specific objects, where a particular kind of metal is sought to be produced continuously. So far as theory goes, the labors of metallurgists and chemists have probably left little to be learnt: but in point of practice, it is equally certain that for want of some ready means of determining with approximate accuracy the composition of furnace gases, much is left to guesswork. It is true that there are at the command of scientific investigators methods of extreme sensitiveness and delicacy; but there are few or no factory appliances available for every-day industrial purposes in the hands of ordinary artisans. Such a desideratum for gas-analysis it is the purpose of the apparatus now described to supply. This, like Frankland and Armstrong's is a modification of Regnault's apparatus for the analyses of gases, designed by M. H. Orsat, a manufacturing and industrial chemist of well known repute. It is dependent for its action upon well known chemical affinities, and applicable throughout a very wide range of industries, more especially those in which gaseous agents are employed, such as atmospheric air, chlorine, or carbonic acid, or those complex mixtures generated in blast or regenerating furnaces, or in coal-gas manufactories.

In all manufacturing reactions where gases are concerned, the immense volumes required form an important element, of which it will suffice to cite two examples. In the case of the free combustion of coals on a furnace-grate, assuming only one half the air to be perfectly utilised, the air required weighs at least twenty-five times the coal burnt. Similarly in a blast furnace it has been estimated that the total weight of the gases, which have conduced to the reaction, is more than six times that of the iron produced. Notwithstanding the increasing tendency of the age to invoke science to the aid of industry, however, and the manifest importance and utility of such a study, gas-analysis has not yet been assigned a place among the resources of industrial practice; and this may be attributed partly to the difficulty of dealing with gases and measuring them; partly, also, to the delicacy of laboratory apparatus employed, and the duration of analytical operations. But, inasmuch as the gases which are of primary importance in industrial technology are few in number, and their action is almost invariably dependent upon the predominance of some one element in particular, it might easily be supposed possible to devise some apparatus sufficiently easy to use, and strongly constructed as to admit of its being placed in the hands of workmen of ordinary intelligence; while dispensing with the pneumatic trough of water or mercury, and requiring neither thermometrical nor barometrical corrections, it may thus be capable of giving rapid and mutually comparable indications.

These are the objects sought to be attained by M. Orsat's apparatus, which consists mainly of a measurer, a blower or aspirator, and two or three "eprouvettes," or testing-glasses, containing bell-glasses, the whole duly connected by suitable tubes and cocks.

The measurer is a graduated tube, A B, immersed in a water-jacket, whereby a constant temperature is maintained. The graduated tube is connected at its upper end, A, with a horizontal capillary tube provided with a cock, C, whereby the gases are admitted to the apparatus; its lower end, B, is connected by a flexible tube, O, with a movable glass flask or vessel,



D, provided at its lower end with a short tube outlet. The flask, D, is half full of water, so that it acts when depressed, as an aspirator, and when elevated, as a blower. The horizontal tube itself has two downward branches also fitted with cocks, G and H, and is connected thereby with two bell-glasses placed within two jars, E and F, which contain absorptive liquids.

Within the first jar, E, is placed a solution of caustic potash; and its bell-glass is filled with a bundle of glass tubes, open at both extremities, of which the internal and external surfaces facilitate the absorption of any gas allowed to penetrate to the interior. The second vessel, E, contains an ammoniacal solution of sal-ammoniac; and the interior of its bell-glass is filled with a sheet of fine copper gauze rolled into the form of a spiral, which not only acts physically, like the tubes of the other bell-glass, but becomes, in presence of the ammoniacal solution, an absorbent of oxygen and carbonic oxide.

The conducting tube, N, by which the gaseous mixture to be examined obtains access to the apparatus, may be of suitable length, and, if necessary, the gases can be subjected to a cooling process. The final length is, of course, inserted into the apparatus under examination; may be of variable length sufficient to permit of obtaining a gaseous vein at various distances from the internal periphery of the furnace; or, better still, may terminate in a long tube with a longitudinal slit, permitting the gas to be drawn simultaneously over a considerable extent,

As an appliance for cleansing the tube, N, and expelling any gas remaining in the apparatus a fourth cock, I, is provided, communicating with a vertical water tube, L, and inlet and outlet pipes, K, M. By causing a moderate current of water to flow through this tube, sufficient suction, as in the Sprengel pump, will be generated effectually to cleanse all the gas out of the apparatus and tubes.

The first bell-glass, E, acts on all gases of which potash is an absorbent; the second on those affected similarly by the cupreous ammoniacal solution; and these indications will suffice in the majority of cases. Thus, for example, in the examination of combustion gases, carbonic acid is absorbed in the former, and in the latter carbonic oxide and oxygen, while nitrogen remains in the measuring tube.

These measurements, by a simple calculation, will give the centesimal composition of any gaseous mixture of nitrogen, oxygen, and the two oxides of carbon, the four gases most usually occurring in furnaces and chimneys. Thus, supposing that 100 volumes of gas are examined, let

x=the volume of nitrogen.
y=that of oxygen plus the carbonic acid.
z=that of carbonic oxide.

Then—

$$x+y+z=100$$

$$\frac{x}{y+\frac{z}{2}}=\frac{79}{21}$$

Replacing y in the second equation by its value in the first, and simplifying, we have

$$100=7900-79-\frac{z}{2}$$

thus giving the value of 2 corresponding to the value of x as ascertained by actual measurement.

To avoid the necessity of constant calculation, two tables are furnished for use with the apparatus; the first giving the increase in volume of 100 measures of air when its oxygen is converted partially or wholly into carbonic oxide; and the second, calculated from the first, shows in 100 volumes of air in which carbon has been burnt, the relative proportion of nitrogen to

the other gases. The figures are based on the fact that when oxygen is burnt to carbonic acid no alteration of volume occurs, while on conversion into carbonic oxide it is doubled in bulk. An example will show how these tables are used.

Supposing that out of 100 measures of a gaseous mixture caustic potash absorbs 1·5, and the cupreous ammoniacal solution absorbs 11·5, the volume of unabsorbed nitrogen being 73, the composition of the mixture may be described thus:

Carbonic acid	8·5
Carbonic oxide and oxygen	18·5
Nitrogen	73·0
	100·0

But as it is requisite to determine the amount of free oxygen, the table is referred to. From this it appears that 73½ per cent. of nitrogen corresponds to 15·19 per cent. of carbonic oxide. This figure, deducted from 18·5 leaves 3·31 as the percentage of oxygen, and the composition of the mixture is ascertained to be:

Oxygen	3·31
Carbonic acid	8·50
Carbonic oxide	15·19
Nitrogen	73 00
	100·00

The tables also show that the original volume of air thus partially consumed must have been 92·41.

Of course, if it is considered desirable to estimate the oxygen and carbonic oxide separately, this can be effected by the use of a third eprouvette and bell-glass containing either pyrogallate of potash, or sticks of phosphorus in glass tubes. Absorbents must be selected with special reference to the gases intended to be determined, and in any exceptional case there need be no complication of the apparatus involved, beyond the addition of one or more bell-glasses. For the examination of gases which are extremely soluble in water, accuracy will be secured by the use of glycerine as the active fluid agency in the aspirator.

In most cases a single analysis would suffice to indicate the behaviour of any furnace, seeing that regularity of action depends on the influence of a particular gas; thus, *e. g.*, for the continuous examination of the products of a gasogen, it may suffice to determine the proportion of carbonic acid.

Among the various useful applications of gas analysis may be enumerated: the examination and supervision of combustion-processes of all kinds, from that of the simple grate to the most complex gas-generator; also of divers kinds of smelting and reducing furnaces, from the cupola to the blast-furnace; reverberatory, puddling, cupellation, and alkali furnaces; likewise the converters of Bessemer, the rotary puddling-furnaces of Danks, and all other such special processes; in connection, also, with carbonic acid generation processes, and the manufacture of carbonates and bicarbonates, sugar, aerated waters, wine, vinegar, and beer; with fermenting and decomposing processes, treatment of manures, cake, pulps, tannins, tobacco, etc.; the manufacture of sulphuric acid, the roasting of sulphur and matt, and bleaching by chlorine or gaseous sulphurous acid.

In hygiene it may have valuable uses for analysis of deteriorated atmospheres of hospitals, theatres, public buildings, dwellings; and in constructive works, in the ventilation of mines, diving-bells, and tubular foundations.

In its special application to the determination of carbonic oxide and carbonic acid volumes in blast-furnaces, and the like, it admits of modification, enabling not only multiplied or continuous results to be available, but also a number of such apparatuses to be located in any manager's office or other suitable place, so as to subject the action of many furnaces to the separate and continuous supervision and control of the superior, apart from and independent of, or in conjunction with, the workmen engaged, as may be desired.—*Iron.*

[Original Communication.]

Some Notes on the Chemistry of Gas Manufacture.

By Augustus A. Hayes.

[Continued from page 129.]

Many years since a gentleman brought to New York large rectangular blocks of so-called "fossil ebony," from its resemblance to the natural wood. It was a most remarkable cannel variety of coal with a horn-like elasticity and resistance to cross fracture, electric on friction: it could be split but not broken small; was easily worked into varied forms which received a polish. Subsequently as "Breckinridge" coal it became the material for oil production and an excellent enricher of poor gas.

In the tube this coal became pasty, afforded the alkaline water and oils of true cannels. One hundred grains dried at 72° Fah. afforded

	Slowly Heated. Grains.	Rapid Heating. Grains.
Moisture at 480° Fahr	0.55	.55
Oils and gases at 480° Fah	59.45	63.12
Fixed carbon	36.00	32.52
Purplish brown ash	4.00	3.81
	100.00	100.00

The coke softened so as to take the form of the vessel, was black and brilliant.

"*Greenup*" *Cannel, from Greenup County, Ky.*—An average of many analyses. One hundred grains dried at 72° Fahr. afforded

	Slowly Heated. Grains.	Rapid Heating. Grains.
Moisture at 600° Fah	.60	.59
Oils and gases, in all	45.90	49.25
Fixed carbon	49.47	46.13
Ash	4 03	4.02
	100.00	100.00

This cannel affords a compact iron gray coke; the coal expands and may be melted. While burning on a grate drops of fused compounds fall and burn with a brilliant flame. The ash is nearly white, and the coal slowly distilled affords a large volume of oil.

Coal from Island of Saghalien, Japan.—This coal forms a large and most promising bed, near tide-water, belonging to the Russian government.

Masses black, shining lustre, columnar with cross rents, seldom at right angles with planes of deposition; quite uniform, brittle, divides at joints easily and exhibits the whorls, which always denote excessive fineness of material. One hundred grains afforded

Moisture, 480° to 650°	2.65
Oils and gases, 480° to 650°	25.35
Fixed carbon	69.00
Pink colored ash	3.00
	100.00

The iron gray colored coke was double the volume of the assay. In the retorts the coal affords a nearly colorless oil if slowly heated, and the mixed vapor and gas burn without much smoke. It is a valuable fuel for heating steam boilers, subject to the drawback of brittleness. As a basis coal in gas making it is well adapted.

Pictou N. S. Coal.—This well known *basis* gas coal has been the subject of much study. Found in the same coal measures which contain the various kinds of provincial coals, it offers with these an excellent illustration of different constitution of humus, resulting in different coals, under like exposures. In its mass it consists of unlike bodies, the laminations often show beautiful forms of mineral charcoal, and its sulphur compounds are in less proportion than exist in the other coals of this formation. Sections show an aggregate of remains of leaf and other forms of humic remains. With suitable enricher, almost any desirable quality of gas for illumination can be made from it, and its secondary products are not troublesome in working.

This coal with others has been wholly converted into gas, and the secondary salts and aqueous products kept apart. Results reduced to correspond with the proportions given above, illustrate the mode of working with a heated retort and sudden breaking up of the coal constituents. One hundred grains of dry Pictou coal in thimble-form retort afforded

Fluid saline matters and acids	10.26
114 cub. in. gas, and vapor of water	16.61
Coke	73.13
	100.00

The gas here weighed was saturated with vapor of water at 60° Fahr., as in manufacturing. It did not contain any carbonic acid. Bromine reduced the volume 4.50 per cent., withdrawing illuminating vapors. The observed illuminating power was 14.5 standard candles. It will be observed that no coal tar is noted as a product. To this point attention is again called, as it is stated as an experimental truth, which any one can verify.

[To be continued.]

American Water-Gas Researches.

REPORT OF PROFESSORS SILLIMAN AND WURTZ.

[Continued from page 131, No. 6.]

Carbon in the Retorts.—It is by no means one of the least advantages incident to the hydrocarbon process, that it *effectually prevents the deposit and accumulation of solid carbon in the retorts.* This evil is one keenly appreciated by all practical gas men, and numerous devices have been adopted, or proposed, to remedy it. In effect, the loss arising from this cause is not less than 8 per cent. of the total efficiency of the number of benches in use, while the labor costs, and fuel burned, are undiminished.

INCIDENTAL PRODUCTS, OF A SALABLE CHARACTER.

The tar from a series of five benches of five retorts, burning off, say 9⅔ tons of coal, will be at 9 gallons per ton, say	87 gallons.
The ammoniacal liquor from the hydraulic mains by the hydrocarbon process is shown by our experiments (see Section on Ammonia) to be very strong, having a strength of 1420 grains of absolute ammonia to the gallon, or, as compared with the strength of the liquor from the same coals by the ordinary process, as 2·29 : 1.—nearly 2½ times stronger. Taking the usual estimate of 10 gallons of ammoniacal liquor to the ton of average caking coal, we shall find from 9⅔ tons of coal, ammoniacal liquor (density, 1032)	92 ½ gallons.
Containing of absolute ammonia	18·72 lbs.
Surplus coke available for sale	60 bushels.
The waste lime from the purifiers, say	35 bushels.

It will be seen from this statement that the incidental products by the hydrocarbon process are by no means inconsiderable. It is proper to say, in this connection, that the value of the tar for the laying of wooden pavements and gravelled walks (its most important use in this country), is increased by the hydrocarbon process, and the residual product should command, therefore, as much money as before; that is, the price per barrel will be advanced 20 per cent. The loss of its more volatile ingredients is an advantage for its use in making pavements.

We have selected a bench of five clay retorts as the term of comparison between the results of the hydrocarbon process, and the common process, because it is the form of oven most commonly in use in the United States, and the coals used in illustration, or their equivalents, may be obtained almost anywhere.

At Fair Haven the benches had three retorts each, the upper one being the anthracite retort, which makes a very convenient arrangement for caking coals, with 10 per cent. to 15 per cent. of enriching coals added; but, for cannel coals, the reverse order is required, as already indicated in the plan described for a bench of fives.

The arrangement of "sixes" is also equally convenient, being the last-named arrangement doubled, with the two upper retorts for anthracite.

The majority of engineers will, in short, adapt the system as their varying necessities may require.

COST OF THE WATER-GAS, IF MADE BY ITSELF.

We have given some consideration to this point, which suggests itself as one sure to be of much importance, aside from the use of the water-gas in the hydrocarbon process for illuminating purposes; for example, in the use of water-gas for heating, cooking, metallurgical operations, and as a motor. The elements of cost are: (1) the prime cost and wear and tear of the apparatus; (2) the fuel consumed to heat the retorts; (3) the anthracite consumed to decompose the vapor of water; (4) the fuel required to produce steam, provided the waste heat of the benches is disregarded; (5) purification; (6) labor; (7) administration and incidentals.

With these data it is easy to fill up the following schedule for a bench of five anthracite retorts, holding, say 600 lbs. of anthracite each, thus:

Five anthracite retorts set in one bench produce 7,000 cubic feet each of purified hydrogen and carbonic oxide gases as the daily product, equal 35,000 cubic feet.

Anthracite consumed in retorts, say 90 lbs. × 5 = 450 lbs.

Steam fuel, say 16 lbs. × 5 = 80 lbs.

Lime (4,000 feet per bushel), say 8 bushels.

Labor.

Administration, taxes, repairs, etc., etc.; say 15 per cent. of all other costs.

RECAPITULATION.—These data are convertible into values for this place, thus, viz.:

450 lbs. anthracite, at say $8 per ton.	$1.35
42 bush. coke, 8 cents per bush.....	3.36
8 bush. lime, 12½ cents per bush.....	1.00
Labor, say.....	3.00
	8.71
Add 15 per cent. for administration, taxes, repairs, interest and incidentals equal.....	1.30
Cost of 35,000 feet of water gas equal	10·01
" 1,000 cu. ft. of water-gas (in U. S. currency) equal.....	$ 0·286

This calculation will vary, of course, somewhat with the locality. The labor of one fireman is all that will be required, as there are no bituminous charges to stoke or remove.

The high heating power of this gas has been fully demonstrated by our calculations in the Section devoted to that subject; and it becomes, therefore, a matter of considerable practical importance to ascertain, as nearly as may be, its cost. It will be important, when it shall be brought into use as a heating agent, to impart to it a sufficient degree of odor to secure those who use it from any risk arising from its accidental escape.* Probably petroleum naphtha may be employed, in small quantity sufficient only to impart odor; and naphthaline is another waste product which may be used for this purpose. Owing to the production of acetylene in the combustion of common street gas, when used for cooking or heating, serious objections have very properly arisen to gas stoves employed in apartments, as this agent is found to induce headache and nausea. To the use of the water-gas alone, no such objection can arise, as its sole products of combustion are water and carbonic acid.

[To be continued.]

Explanatory Regarding "Wollongongite."

[In the last issue the following documents were referred to, received by us at the hands of Prof. Silliman. We have thought it best to reproduce them in full. It will be observed that they are now more than four years old, but it is due to American readers that they should be rightly informed on this subject.]

ST. LEONARDS, NEW SOUTH WALES,
February 25, 1870.

My Dear Sir: I have to thank you for a copy of your interesting paper on "Wollongongite" sent to me through the American Consul at Sydney,, H. H. Hall, Esq.

[My friend Mr. Hall accompanied it with a Mss. note appended, stating that the specimens you examined came not from the neighborhood of Wollongong but from the Blue Mountains, *i. e.* from Reedy Creek, now called Petrolia, in the Blue Mountains, below Mount York, on the *western* road whereas Keera is not on the Blue Mountain ranges, but at the back of the Illowarra and to the *south* of Sydney.

A mistake of this kind is so important in relation to the commercial interests of companies working different localities, that I deem it only a duty to you, who have done so much to elucidate this new product, to point it out.

This will also explain why my friend Dana could not have *overlooked* the occurrence of the formation, as he was not at the place at all.

I was with him in his Illawarra journeys, and I was also on the Blue Mountains, within a few miles of Reedy Creek, when Mr: Hall was returning from his visit to the locality named by me, with the specimens he sent you, and we conversed about them.

I have forwarded with this a passage about Reedy Creek in a paper of mine, which you will find in the *Quarterly Journal* of the Geographical Society of London, vol. xxii, part I., page 445; and if you will look to another paper, reprinted in your *Journal of Science*, you will find further mention. The half elastic substance named by you at page 9, I recognise as *working the thicker beds in the drift at Petrolia.*

I am sure you will kindly pardon my troubling you, as my only object is to thank you for the paper, and to put you in the way of not perpetrating an accidental error of some importance here, though of none to the mineralogical world at large.

Yours very faithfully,
W. B. CLARKE.

Professor Silliman.

(Extracts referred to in the above.)

REEDY CREEK.†—On the eastern arm of the fork at Mount York, which is now called Mount Dixon, there exists a bed of very rich iron-ore; and iron also occurs near the head of the Reedy Creek valley, which extends to the west. Below the ironstone occur sandstones, shales, and coal-beds; but at the level of the valley the cannel stretches across it, and when I first visited it, seemed to consist of blocks of from 6 to 12 inches thick. Now that the seam has been opened and worked into the boundary ranges, it is found much thicker than was anticipated.

The section is as follows:

	feet.	inches.
Ironstone.....	0	3
Shale	1	0
Rich Cannel.....	4	0
Cannel Coal, less rich.....	0	6
	5	9

The Cannel dips about east by north at from 1° to 2°, or about 1 in 35; in places it is full of fronds of *Glossopteris*, and a plant branching after the manner of *Asterophyllites*, which lies in perfect unrumpled order; it also puts on a prismatic structure, and has a flat but well-marked conchoidal fracture. The shales are impressed with *Vertebraria*, *Glossopteris*, and *Gongnopteris* (M'Coy). The Cannel passes into true bituminous coal in parts of its course; and the shales in contact are earthy, but very inflammable. The toughness is remarkable. The produce of the rich Cannel is from 150 to 170 gallons of oil (realizing 100 gallons of pure oil) and from 1700 to 1800 cubic feet of gas to the ton This seam appears, by borings commenced in the vicinity of Mount Victoria and to the east of the first workings, to be extremely variable in dimensions and composition. At the Sugar-Loaf, part of the Mount Victoria range, a seam was pierced which is but two feet thick. It is supposed to represent the Reedy Creek seam, but as it is 300 feet or so above that level, it would rather belong to the coal-seam at the height of 3000 feet on Mount York. A further discovery of Cannel, but not so rich as the original, has been made south of the foot of Mount Victoria, in two spots where the Cannel proved to be from 15 to 18 inches and 21 inches respectively. It is, so far as is at present known, quite clear that these seams are in patches, and not of uniform thickness; and consequently it would be premature to build expectations of any kind as to the extent in space occupied by them.

* The unpurified gas has a sufficiently disagreeable odor.
† It was from this locality not Mount Keera or Wollongong the specimens of Prof. Silliman were taken.

"WOLLONGONGITE."

In the January number of the *Quarterly Journal of Science* (No. XXV. page 126) occurs this sentence: "English ears will not readily get reconciled to the sound of *Wollongongite*—the name which Prof. Silliman proposes for a new native hydrocarbon, which promises to become of great technical importance."

This name, as I propose to show, is a *misnomer*, and I wrote to that effect by the February mail to Prof. Silliman, from whom I received a few days before, through the kindness of Mr. H. H. Hall, Consul of the United States, a presentation copy of Prof. Silliman's paper on the subject, reprinted from the *American Journal of Science and Art* of July 1869, (p. 85).

Wollongongite is intended to represent "a variety of cannel occurring abundantly" in New South Wales, but ascribed in the in the instance in question *erroneously* to the "Wollongong district of the Illawarra Coal Field."

In the year 1863, Mr. Hall visited the locality near Mount York, since called Petrolia, in company with Mr. Hebblewhite, and procured specimens, which, in the year 1866, he took to America, and which were submitted to examination by Profs. Wurtz and Silliman, of Yale College, Newhaven, in Connecticut. As I happened to be at Blackheath on their return in January 1863, I had conversation with Messrs. Hall and Hebblewhite on the subject of their journey, and know that such specimens were procured by them.

It seems, however, that Mr. Hall took with him to the United States specimens from under Mount Kembla, and by some mistake those examined by Profs. Wurtz and Silliman have been confounded with the Illawarra cannel.

This is by no means conjectural. Mr. Hall has given me, in writing, the following memorandum attached to the copy of Prof. Silliman's paper:

"The specimens I gave to Prof. Silliman were Blue Mountain and Wollongong shale. He appears to have confounded the Blue Mountain with the Wollongong. The specimens from which his experiments have been made were Blue Mountain."

Of this mistake Prof. Silliman gives clear proof; for, he says of the mineral: "It is found in the Wollongong district of the Illawarra Coal Field, New South Wales, and in the *range known as the Kembla Mountains, or Blue Mountain Range.* The locality appears to be of recent discovery, as the section taken down from Mr. Hall's dictation is quite different from any section given by Prof. Dana in his account of the Illawarra Coal Field." And in a foot-note to this passage the author adds, in reference to Prof. Dana's account in the United States Exploring Expedition, pp· 449, etc.: "This remarkable mineral was discovered long subsequent to the date of Prof. Dana's exploration in 1840. The writer examined and analysed the coals brought home by Prof. Dana from Australia, which analyses are published on page 476 of the report quoted. Bnt among them there was nothing at all resembling the remarkable body now for the first time, as he believes, introduced to the knowledge of gas chemists."

All this is quite true. I accompanied Professor Dana in his explorations of Illawarra, in January, 1840; and Sir William Manning will, I daresay, recollect an evening we all spent together at Wollongong, before Prof. Dana left that place. My friend Dana and I, after a few minor explorations about Keera, etc., travelled by way of Ghoongorrin to Daisy Bank, where we dined with Mr. Osborne, and then ascended the steep mountain pass to the head of Tsesingjowera Waterfall, crossed the track from Kiama, and descended by Stewarts Valley to the Kangaroo Ground, where passed the night. We then crossed, by way of Broughton's Creek, and were entertained hospitably at Cooloomgatta by Mr. Berry. Next day Mr. David Berry accompanied us to the top of Cooloomgatta Hill and to Black Head, whence, by way of Kiama and Terry's Meadows, we returned to Wollongong, and by land to Sydney—examining all the way, the geological features of the country.

But Mr. Dana did not at all visit the country about Kembla, nor did I till some time afterwards. On one occasion, however, I walked up and down with Mr. W. Meares to and from Wollongong and Mr. Shone's camp, at the head of Cornerux River, starting at 7 o'clock one morning, and reaching the sea again at 2 o'clock the next, in order to check my barometrical measurements of the height of the escarpment. In this traverse going up, we crossed the coal seams, and examined them hastily; but they were not then worked. We came down American creek in the dark, and I did not see them again till long after.

This statement explains what seems strange to Prof. Silliman, relating to my friend Dana, to whose accuracy in observation and recording I most unhesitatingly confirm

The mineral that is now called Wollongongite was seen, however, not in the Illawarra, but where it does occur, on Reedy Creek, now called Petrolia, by Count de Strzelecki in 1839, as he told me in Fort Macquarie, at an entertainment given by Commodore Wilkes and his officers, at which I was present; but the Count did not publish his researches in New South Wales till 1845, when he wrote thus: "With the deposits of the three above described basins we may connect partial outcrops of coal, observed in a small valley called the Reedy Valley (the Vale of Clywd), north of Mount York and east of Mount Clarence, and which seemingly belong to the Newcastle basin; a probability, however, rather invalidated by the fact of *the coals overlying masses of pure bitumen—a circumstance not discovered to exist elsewhere.*"—[*Physical Description*, p. 120.]

[To be concluded.]

Naphtha for Street Bonfires.—In this city, recently, a one horse truck laden with twenty-seven cases of naphtha was being driven up Third avenue by an employee of the Gas Meter's Saving Company. When near 14th street, the driver struck a match and threw the end of it among the cans. In an instant the whole contents were in a blaze. The driver sprang outand left the vehicle to its fate. The horse, a fine young animal, reared and plunged with fright, but the traces and harness confined him to the burning pile. Superintendent Hartfield, of Mr. Bergh's society, riding up on a car, sprang off at the spot, and under a scorching fire, unhitched the animal and saved it from a horrible death. In ten minutes the wagon was a small heap of charred fragments. The flames reached the top story of the house at the corner of 13th street and Third avenue. An alarm of fire was sounded by telegraph, and the hook and ladder apparatus was quickly on the spot and assisted to put out the flames.—*Scientific American.*

During March, 1874, Pennsylvania Central Railroad shipped 24,000 cars of freight from Philadelphia through to New York. This is considerably greater than during any previous month in its history, and the amount of through freight is steadily increasing week by week. The coal and coke tonnage last week was 63,786 tons, and for the year 802,898 tons. Of anthracite and bituminous there were 532,902 tons, and of coke 113,495 tons.

Correspondence.

[Correspondents, in all cases, should sign their communications with their names and address in full—not necessarily for publication, but as a guarantee of good faith.—Ed.

Scholl's "Gas-Perfector."

March 30, 1874.

Mr. Editor: Scholl's Gas Perfector was patented in England June 20, 1865, and was first advertised with a cut, in the London *Journal of Gas-Lighting* July 23, 1867, page 598. It consisted of a thin disk of platinum so attached to a metallic ring, that on placing the ring over a fish-tail or batwing burner, the disk would stand upright in the midst of the flame.

On September 25, 1865, John Wright and William H. Williams obtained a patent for certain improvements in fishtail burners, in which a similar device is mentioned; the disk being of steel or other metal inserted in a slot cut in the top of the burner (London *Journal of Gas-Lighting* for 1869, page 703). This was first advertised with a cut on page 843 (1869). In the advertisement it was claimed that "If a thin piece of steel, such as a knife blade, be held across an ordinary gas burner, so as to divide the flame, the whole of the gas is consumed, and an increase of light is at once apparent. Careful experiments have shown that 63 per cent more of light is obtained from the same quantity of gas."

Through the kindness of Mr. Greenough, agent of the Boston Gas-Light Company, and of N. C. Nash, the famous gas agitator of Boston, I had an opportunity of examining both these devices. As a result of many careful experiments I found that both gave nearly the same photometric results: though with neither were the result quite equal to those obtained from the brass burners then so common.

That the perfector was quite an important addition to the burners with which it came, was at once shown by the great diminution of the light on removing it; but there was an equal or greater diminution of the light upon placing it over the *brass* fishtail.

While by its removal from its *own* burner the flame became thin and blueish, indicating too great rapidity of combustion; by its addition to the brass burner the flame became dull and smoky, indicating an approach to the other extreme—too slow a combustion for a perfect light.

Scholl's Gas-Light Perfector is then only an expensive device for improving the lighting qualities of a poor burner, and with such a burner doubtless Letheby of England, did find an increase of 63 per cent. in light on its addition. But in America at least there need be no poor burners used, since good ones are manufactured so cheaply that old poor ones may be discarded entirely. Yours truly,

Fred. E. Stimpson,
Late State Gas-Inspector of Mass.

A Model Gas Works.

Cleveland, March 27, 1874.

Mr. Editor: The Bloomington gas works possess the great and somewhat rare advantage of an excellent location and a generous breadth of ground, sufficient for all the extensions which the future growth of the city may render necessary. A copious stream of water flows through the grounds, furnishing an abundant supply for the works, and acting as an effective drain.

Good coal is mined within a few rods, and delivered without rehandling in the sheds. The track of the Chicago and Alton Railroad lies directly upon the east, at an elevation which permits the dumping of coal brought from a distance direct into the sheds.

The grounds are tastefully laid out, the walks, roadways, and yard, being paved with concrete. The buildings are elegant and substantial brick structures, slate roofed and susceptible of easy extension.

The retort house contains ten benches of threes, placed back to back. The gas is conveyed to the exhauster through 8-inch pipes laid underground, and acting of course as partial condensers. The exhauster has a capacity of 250,000 feet in twenty-four hours, and runs with admirable ease and precision. The purifying house, which is large and well ventilated, is supplied with four purifiers 8 feet by 12 feet in the clear and 3 feet in depth.

The holder is 65 feet by 22 feet, and is a very handsome piece of workmanship, but will soon be too small to supply the wants of the thriving little city, through whose delightful streets and broad avenues are laid the sixteen miles of main pipe, which supply 1100 consumers and 420 public and railroad lamps with gas.

The gas furnished is very pure and of high illuminating power, and the results generally for the seven months preceding my recent visit were somewhat remarkable. During that time Bloomington coal (South Shaft) was used exclusively, the average yield from which was 3.68 feet per lb.; the yield of coke 1162 lbs. per ton, possessing good heating qualities, and having but little tendency to clinker; 6000 feet of gas was purified for every bushel of lime used, and *no naphthaline was formed*, notwithstanding the high heats maintained.

The average daily production was 68,000 cubic feet, but upwards of 102,000 feet have been made in 24 hours, and the remainder once during the day and twice during the night.

The works were erected by General A. Gridley in 1867, and are owned and controlled by him. The general plan and design of the works is as nearly perfect as human skill and ingenuity can suggest. A wise liberality has characterized their management, and under the efficient superintendency of Mr. E. W. Bailey, results have been obtained which may fairly challenge comparison with those of any works of their class in the country. Sargent.

A Bit of Gas Chemistry.

New London, Conn. March 28, 1874.

Mr. Editor: Will you allow me to make a chemical inquiry of you in relation to gas compounds, or rather compounding of gases.

Can carburetted hydrogen gas and carbonic oxide gas be *fused*, or made to *unite* by means of *heat*, so as to form *one compound* gas? If so, what degree of heat is necessary for the purpose? Is there any *test* known to the science of chemistry by which I may *determine* whether such a *union* has been made—a *test* which shall show that the gases are not *mingled* or *mixed* but united? Yours respectfully,

A. C. Lippitt.

[For remarks see editorial page.]

Philadelphia, March 27, 1874.

What was the Economy?

Mr. Editor: I had placed on my meter a Gas Governor, and from February 21st to March 21st the consumption was 42,000 feet. The previous consumption from January 21st to February 21st was 70,000 feet. What percentage was saved, the burning being equal, all but the difference of time of lighting, the days being shorter as the year advances? Or, about what percentage should I allow for difference of time? Yours truly, A. B. C.

[The saving of *consumption* here must certainly have been enormous. Whether it was all, however, strictly speaking, economy of *light*, that is, whether the governor did not merely act to prevent sheer *waste* of gas, may admit of grave doubt. As to the precise calculation asked for by our correspondent, that is, the elimination of the effect of the later hours of lighting of the gas—unfortunately he has omitted to state an essential factor, that is the *hour of extinguishing* the gas, supposing this latter to have been uniform. —Editor.]

Seeking Information.

Office of the Newburgh Gas Co.,
Newburgh, New York, April 20, 1874.

Mr. Editor: Can you inform me, or tell what authority I can find for the temperature to produce gas from crude petroleum. And if the temperature be at, say 1800° Fahr., would not the illuminating power be lessened? If heats are higher still, it would be so much oil wasted. Your answer would greatly oblige

Yours respectfully,
John A. Boyd.

[Received so late that no room for reply.—Ed.]

New Gas Works,—The late legislature of New Jersey passed the following bill: To incorporate the Citizens Gas Light Company of Elizabeth; to incorporate Citizens Gas Light Company of New Brunswick.

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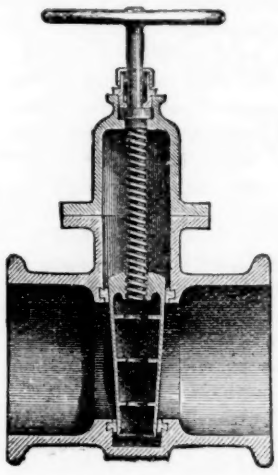

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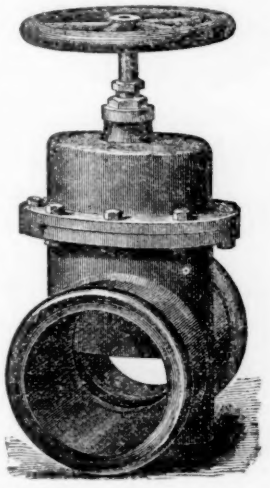

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SATURDAY, MAY 2, 1874.

WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

Subscribers would confer a favor upon us by remitting *CHECKS*, or *POST OFFICE MONEY ORDERS*, as we are frequent losers where money is enclosed in letters.

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GAS-LIGHT ASSOCIATION OF THE UNITED STATES.

In accordance with the 8th Article of the Constitution of the Gas-Light Association of the United States, the semi-annual meeting of this Association will be held in the city of Cleveland, Ohio, on the second Wednesday of May, 1874, at 10 o'clock A. M. The members of the Association consist of all regularly organized gas light companies, represented by not more than three delegates each, and of individuals engaged in supplying towns with gas, who may become members by the payment of $10, and an annual fee of $10 thereafter. The Constitution of the Association has been forwarded to all the companies in the United States. If any have not received it, and will apply to the Secretary, it will be sent. It is desirable that all companies intending to be represented at this meeting should forward their fees to the undersigned. It is expected a large attendance will be present. Several of the most prominent gas engineers, and others, will present important papers for the consideration of the Association.

P. E. DE MILL,
Secy. and Treas. of the G. L. A. of the U. S.

REPORT UPON THE NEW YORK AND CLEVELAND GAS-COAL COMPANY'S YOUGHIOGHENY COAL.

BY PROF. HENRY WURTZ.

This coal, received from the above Company through the hands of W. H. Waterbury Esq., their Eastern agent, has been submitted to complete examination, by the undersigned. It comes from mines of this Company in the Youghiogheny seam, located in what is known as "Pool No. 2."

The coal was sampled with care and labor, by crushing coarsely, mixing uniformly, and sifting out dust. The density was found to be 1·286. The analysis gave the following figures:

Moisture		0·61
Volatile matter 39·34		38·83
	Sulphur	0·51
Coke, 60·05	Fixed Carbon	54·79
	" Sulphur	0·68
	Ash	4·58
		100·00

The above proportion of volatile matter, 39·34 per cent., is the utmost that can be expelled at the highest heat, by the mode of operation used by the undersigned, that is, with a platinum crucible which is left uncovered until the flame ceases. It may be taken as representing what may be accomplished at highest working heat, in clay retorts with an exhaust. It was found difficult to realize it in the iron test-retort. In one case, however, in the latter, the total volatile matter came up to 36·87 per cent. The coke was dense, in volume about equal to, probably slightly less than, the coal—say 33 bushels per long ton, weighing 1,390 lbs. A sample of the coke accompanies this report.

The ash is grayish. It requires for agglomeration a heat higher than that of a Bunsen burner, and does not fuse into a glass at the highest blowpipe heat, so that no clinkering need be apprehended. The above proportion of volatile sulphur is small, much less than the average of gas coals, as was to be expected from this vein and district. Two bushels of lime per ton will suffice for the purification of the gas from this coal.

The actual gas test of this coal in the iron retort gave, as the maximum yield of gas, after condensation and purification, 4·685 cubic feet per lb. (or 10,500 feet per long ton) of 15·6 candle power. This is equivalent to a "standard yield" of 9,500 feet per long ton—or 4·25 feet per lb.—of over 17 candle power (exactly 17·24 candles).

This is equivalent to 561 pounds of spermaceti, per long ton. This is a little higher than the average of the gas coals of this coal-field, which may be rated at 545 pounds per ton.

HENRY WURTZ.

PETROLEUM-GAS WORKS NEAR THE METROPOLIS.

Among our excerpts to-day (No. 1092), will be found copied a newspaper notice of an experimental petroleum-gas works, stated to be in progress of erection, at Hoboken, in connection with the establishment of the Hudson County Gas-Light Company.

Since the above was in type, we have had the pleasure of an interview with Mr. Shippen of Hoboken, the President of the Company, who verifies the statement fully. He further informs us that when the parties are ready to make gas, this (the gas) is to be examined and reported upon by President Morton, of the Stevens Institute, in conjunction with Prof. Chandler, of Columbia College, New York; and that, in case of satisfactory result, the gas is to be distributed to the consumers of his district, and the new apparatus to be assumed by his Company. As the private laboratory of the Editor of this Journal—which now comprises the most efficient and improved apparatus for gas-analysis, photometry, etc., to be found in the country, in private hands—is *within the district* of the Hoboken Gas Company, there appears likely therefore soon to be an opportunity for us to make the completest possible examination of petroleum gas, as made by the Spencer process. The profession will receive from us such information regarding the progress of this new experiment, as we may be enabled to lay before them.

ORSAT'S GAS-ANALYSIS METHODS.

The apparatus we describe and figure in this issue, was described also to the New York Lyceum of Natural History, April 13, by Professor Eggleston, with his high approval. At that time, the description we here copy from *Iron*, was already in our portfolio, and the cut in the hands of our engraver for reproduction; but, as we had then unluckily but glanced over the article, we failed to identify it when listening to Prof. E.'s communication to the Lyceum; and probably therefore owe some explanation to that gentleman.

We highly endorse the remark made in this paper that in spite of the manifest importance and utility of gas-analysis, in a great multitude of industrial arts, the methods and manipulations hitherto in use in chemist's laboratories have been too complex, tedious, and delicate, and the apparatus too costly and fragile, for general use. The writer has for many years felt these truths strongly, and has given much labor and attention to the simplification of gas-analysis. It is impossible to enter much into the subject here, and we will but say that the devices and methods of Orsat present points of novelty and value, but that our personal experience enables us to say that the plan will be of rather limited utility. The use of solid absorbents, after the practice of Bunsen, must of course be tabooed, if we wish to gain time; but the exposure of the

gases, for absorption of carbonic acid, to such comparatively large volumes of potash solution, will introduce several errors incompatible with minute accuracy. There are difficulties also about the carbonic oxide treatment, as described, which could not just now be set forth. To give just one example, of a point which this chemist has seemingly overlooked altogether:—what is to be done about *sulphuretted hydrogen*, always a constituent, and often a most important one to know, in furnace gases?

The Orsat plan has of course—as was remarked indeed by Prof. Eggleston, on the occasion above referred to—no great value for *illuminating* gases; and, up to this time, we see but little promise of arriving at methods of handling and operating on most gaseous mixtures, without the use of quicksilver, at least for confinement. Glycerine, used for more than twenty years for coal-gas, by the writer, and in constant use in a multitude of ways by him during that time–which Orsat also recommends to be used—can but rarely be applied in analytical work, and but very poorly replaces quicksilver. An important object for those who seek to facilitate modes of gas analysis should be to reduce the *quantity* of quicksilver to a minimum, which is far easier and more sensible than to try to displace it. The writer has very much to bring forward on these topics in due season.

REPLY TO MR. LIPPITT.

A. C. Lippitt Esq., President of the New London Gas-Light Co., writes to ask whether "carburetted hydrogen and carbonic oxide can be made by heat to form one compound gas?" Mr. L. does not say a *homogeneous* chemical compound, but it is to be presumed that this is what he means. The answer must be in the negative, so far as chemists at present know. "Carburetted hydrogen" is an indefinite term, including—even among the components of coal-gas—a number of distinct substances. The most abundant of these, in coal-gas, is common marsh gas, forming often 40 per cent. Doubtless, however, Mr. Lippitt refers to the illuminating hydrocarbons or carburets of hydrogen (marsh gas, when alone, burning ordinarily without light) of which olefiant gas (ethylene) and benzole vapor are examples. Now no chemist has ever found carbonic oxide to unite directly by any treatment with these compounds. By intense heat, it may be that the carbonic oxide would be partially decomposed, and by the union of its oxygen with hydrogen of the hydrocarbon, steam would be found. In this case there would be a separation of free carbon. The only known result that could prevent the separation, in such a case, of this free carbon, would be the formation of *acetylene* gas, observed many years ago by Berthelot. This is formed however only when most intense temperatures are used, and in very minute quantity even then; and its formation can be of no practical consequence. Its presence can be detected by passing the gas through an ammoniacal solution of copper, when the brick-red insoluble acetylide of copper precipitates.

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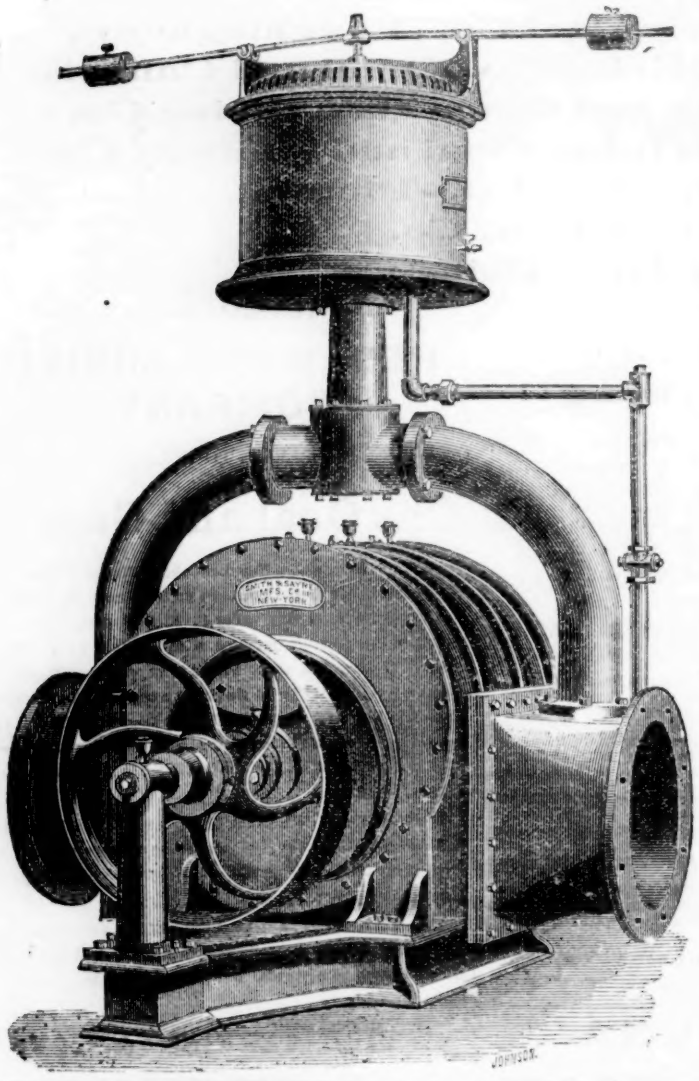

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3d. The saving of lime and labor, as the Screens are not liable to clog, and are easily cleaned.

4th. Their cheapness and simplicity of construction.

5th. Their DURABILITY—they can be used longer than any other now used.

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Dear Sir: The Trays manufactured by you for our West Station were put in use in September last, and have *given perfect satisfaction.*

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The pressure thrown upon the retorts by contracted passages is very great, and were gauges used more frequently than they now are in many gas-works, this facat of having *open Trays* would become more apparent to mangers of gas works. The digerence in pressure at this station in passing the gas through your purifiers, is two-tenths (2-10) inches.

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JAMES H. ARMINGTON, Supt.

BOSTON GAS-LIGHT CO., Dec. 1871.

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Yours respedtfully,
A. M. GILES.

EDWARD DUFFEE, Esq.

EAST BOSTON, JUNE 15, 1871.

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I consider them *by far the best Screen* for Dry Lime Purifiers I have seen. Yours truly, A. M. NORTON, Supt.

CHELSEA, May 1, 1871.

Mr. E. DUFFEE.

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Yours truly, JOHN ANDREW, Sup't.

DORCHESTER, March 3. 1870.

Mr. E. DUFFEE.

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Agent Dorchester Gas-Light Co.

JAMAICA PLAINS, MASS., June 21, 1871.

EDWARD DUFFEE, ESQ.

Dear Sir; The Trays ordered by this company three years ago, are getting somewhat worn. I wish to say here that I consider your Trays to be superior to any yet invented, therefore please make us another set at the price named, to be like the sample shown in every way, and oblige Yours truly
JAMES F. ROGERS,
Sup't Jamaica Plains Gas-Light Co.

BROOKLINE, June 11, 1871.

E. DUFFEE, ESQ.

Dear Sir: You will please make a set of Gas Trays for this company as soon as convenient, at price named. In regard to the merits of the Tray, after having them in constant use for over two years, I will say that I consider them *superior to any Tray* manufactured in this country. Respectfully yours,
H. A. ALLYN,
Sup't Brookline Gas-Light Co.

BANGOR, August 2, 1870

EDWARD DUFFEE, ESQ.

Dear Sir: Yours of the 20th ult. is received. In regard to your Gas Trays, I take pleasure in saying that they have been in use over two years, and have given perfect satisfaction and they are in good order at the present time; should have no hesitation in recommending them, believing they are the most durable and easiest kept in order of any with which I am acquainted. Respectfully yours,
W. H. PERRY, Sup't.

OFFICE OF THE SPRINGFIELD GAS-LIGHT CO.'
SPRINGFIELD, MASS., Oct. 10, 1871.

Mr. WARD,
President Hartford Gas-Light Co.

Dear Sir: I have been using Gas Screens made by the American Gas Screen Company, for nearly a year, and find them superior in every way to the wooden Screens made and formerly used by the Springfield Gas-Light Co. I can purify more gas with the same quantity of lime, there being more surface to the Screens; and I consider them more durable, and recommend them to your consideration.

Yours with great respect,
GEORGE DWIGHT.

ROXBURY, June 14, 1872.

EDW. DUFFEE, ESQ.

Dear Sir: In answer to your inquiry regarding your Patent Gas Screens, I am happy to be able to say, that after nearly three years constant use we are perfectly satisfied with them being able to purify over fifty pet cent. more gas with them than with any other Screen we have used.

Yours respectfully,
THOMAS J. PISHOU

OFFICE DETROIT GAS-LIGHT CO.,
DETROIT, MICH., April 22, 1872.

AMERICAN GAS SCREEN MANUFACTURING CO., HAVERHILL.

Gentlemen: The Screens bought of you work far better than any we have ever used. As a proof, we have with the same quantity of lime purified *twenty per cent.* more gas with your Screens than with any others, and the work well done. The workmen are also better pleased with them—they being light and handy to work. They also relieve the pressure very much upon the retorts, and I cheerfully give yau my experience.

Yours truly,
P. E. DEMILL. Secretary.

We give a list of some Gas-Light Companies using them.

Providence, R. I. Gas-Light Co.. Boston, Mass. Gas-Light Co.: East Boston, Mass., Gas-Light Co.; South Boston, Mass. Gas-Light Co.; Springfield, Mass., Gas-Light Co.; New Bedford, Mass., Gas-Light Co.; Manchester, N. H., Gas-Light Co.; Reading, Penn., Gas-Light Co.; Biddeford, Me., Gas-Light Co.; Hartford, Conn., Gas-Light Co.: New Haven, Conn., Gas-Light Co.; New Orleans, La., Gas-Light Co.; Savannah, Ga., Gas-Light Co.; Charleston, S. C., Gas- Light Co.; Trenton, N. J., Gas-Light Co.; Charlestown, Mass., Gas-Light Co.; Dorchester, Mass., Gas-Light Co.; Chelsea, Mass., Gas-Light Co.; Baltimore, Md., Gas-Light Co.; Manhattan, N. Y., Gas-Light Co.; Cincinnati, Ohio.; Gas-Light Co.: San Francisco, Cal., Gas-Light Co.: Albany, N. Y., Gas-Light Co.; Sacramento, Cal.; St. Joseph, Mo., Gas-Light Co.; Leavenworth, Kansas, Gas-Light Co.; Macon, Ga., Gas-Light Co.; Roxbury, Mass., Gas-Light Co.; Lansinghburg, N. Y., Gas-Light Co.; Bridgeport, Conn., Gas-Light Co.; Stamford, Conn., Gas-Light Co.; Poughkeepsie, N. Y., Gas-Light Co; Scranton, Penn., Gas-Light Co.; Lewiston, Me., Gas-Light Co., and one hundred others.

Address **R. A. POTTER, Treas.,**
Amer. Gas Screen Man'f'g Co., Haverhill, Mass

EDWARD DUFFEE, Agent.

J. L. CHEESMAN.

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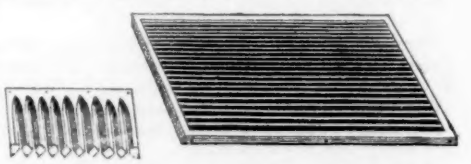
SOLID WOOD TRAYS.

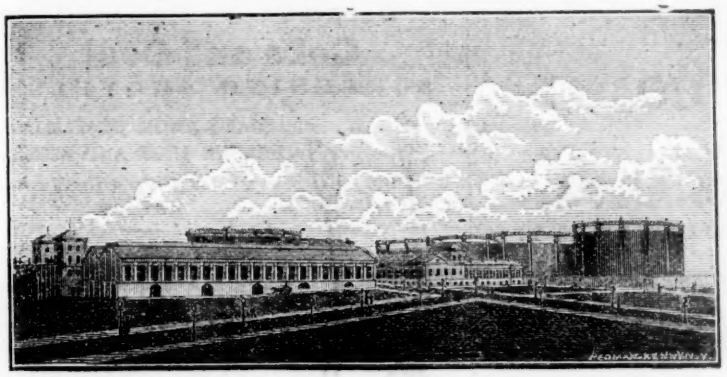
PATENTED OCTOBER 21, 1862 AND JUNE 10, 1873.



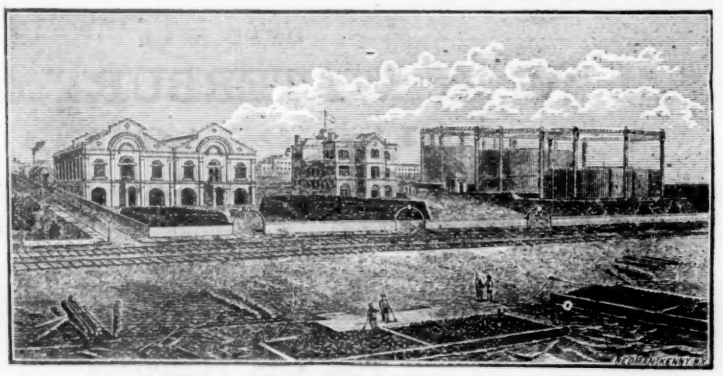
To Gas Companies.

The above Trays will last longer. and are cheaper than any Tray now used. They are now made without any outside strips, which gives more purifying surface, being perfectly smooth. The lime will not adhere to them as in other Trays. They are now used in over three hundred Gas Companies in the United States, and other places.

JOHN L. CHEESMAN,
151 and 153 Avenue C, New York.



CINCINNATI GAS WORKS. ERECTED 1871-72-73.—WM. FARMER, ENG.



ACLEDE GAS WORKS, ERECTED 1872.—WM. FARMER, ENG

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ARCHITECT AND GENERAL GAS ENGINEER,

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WILLIAM FARMER may be consulted upon all matters connected with the construction of GAS WORKS, or any other description of buildings. Will furnish General and Detail Drawings, Specifications and Estimates for Gas Works of any capacity.

PATENTEE OF THE FOLLOWING INVENTIONS:

Exhausters for Gas and Foul Lime Ventilation,
Dumping Barrows for Coal, Coke and Lime,
Hydraulic Mains for Retort Benches,
Blowers for Forges, Foundries, &c.
Pumps for Water, &c., &c.

REFERENCES:

Professor SILLIMAN, New Haven, Conn.
GEN. CHAS. ROOME, President Manhattan Gas-Light Company, N. Y.
A. W. BENSON, President Brooklyn Gas-Light Company, Brooklyn, N. Y.
W. W. SCARBOROUGH, President Cincinnati Gas-Light Company, Cincinnati, Ohio.
S. L. HUSTED, President Laclede Gas-Light Company, St. Louis, Mo.
Prof. HENRY WURTZ, Editor AMERICAN GAS-LIGHT JOURNAL, N. Y.
GEN. A. HICKENLOOPER, Vice-President Cincinnati Gas-Light Co., Cincinnati, Ohio.
FREDERICK CROMWELL, Vice-President Laclede Gas-Light Company, St. Louis, Mo.
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NEW IRON COMPOSITION

Has purified, per bushel, on a single test, 10,000 feet of Westmoreland Gas. With revivification lasts indefinitely. Surpasses in POWER and ECONOMY all known materials. Saves largely in FIRST COST, SPACE, LABOR, SUPERINTENDENCE, and all current expenses. Will purify *easily* sulphurous gas, wholly *unmanageable by lime.* Takes out *all the ammonia.* Now operating in the following Gas Works: Harlem New York (21st street); Port Morris; Hunter's Point; East New York Worcester, Lynn and Cambridge, Mass.; Lewiston, Maine; St, Albans, Vt.; Pawtucket, R. I.; Meriden, Ct.; and being introduced in many other places.

Cost 70 cents per bushel. One bushel for each square foot of Purifier sufficient. Rights to use for life of Patents, for daily makes of gas in thousands; under 25,000 $200; under 50,000, $400; under 100,000, $500; $250 additional for each additional 50,000 per day.

For further information and instructions, apply to

ST. JOHN & CARTWRIGHT,
21st Street and Avenue A, New York Gas Works.

☞ Immediate arrangements are urged, as the demand for the prepared composition is increasing *so rapidly* that delays in supply may occur.

B. S. BENSON.

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Cast Iron Pipes and Fittings,

AND

Gas and Water Mains.

All sizes from 3 to 30 inch cast vertically in 12½ feet lengths

Office & Factory 52 East Monument St.,
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OHIO GAS CANNEL,
From the Sterling Colliery.

We are now prepared to place in the market, through our agents as below, a regular and unlimited supply of this valuable Cannel, for gas purposes. The analysis made in 1871 by Prof. WURTZ, Editor of this Journal, at the Laboratories of the NEW YORK GAS-LIGHT COMPANY, gave 47½ per cent of Volatile Matter and 45 bushels to the ton of a fair quality of coke. The yield of gas was at the rate of 9,500 feet per ton of about 27 candle power. It is not highly sulphurous, can be purified by Lime, and the ash from the coke does not clinker. The above test has been fully substantiated as correct, and can confidently recommend trial of the coal.

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Cast and Wrought Iron Work

Used in the Erection of Gas and Coal Oil Works.

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ALL KINDS OF CASTINGS AND APPARATUS FOR GAS WORKS,

Wrought Iron Roof Frames,

For Retort and other houses Retorts and all castings required for setting them in the latest and most improved model. WASHERS, CONDENSERS, SCRUBBERS and EXHAUSTERS for relieving the Retorts from pressure. PURIFIERS, varying from 2,000 to 2,000,000 cubic feet daily purifying capacity.

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With cast iron guide and suspension frames. GAS GOVERNORS or REGULATORS, STREET MAINS, from 1½ to 48 INCHES DIAMETER, for WATER or GAS. Street Main connections, such as BRANCHES, BENDS, DRIPS, SIEVES, etc.

STOP VALVES, from 3 to 30 inches, for both Water and Gas.

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All the Smith and Sheet Iron work required in and about Gas Works. 226-tf

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TO GAS COMPANIES.

WANTED—BY A YOUNG MAN, A SITUATION AS MANAGER, or would act as Foreman. Has had an almost life-long experience in England, in the Manufacture and Distribution of Coal Gas. Recommendations as to ability can be shown. Understands the manufacture of Sulphate of Ammonia. Address JOHN HANDEL, Peabody, Mass., P. O. Box 334. 255-4t

CIRCULAR No. 2, 1874.

OFFICE OF

W. H. WATERBURY & CO.,

MINERS' AGENTS

AND WHOLESALE COAL MERCHANTS,

P. O. Box 1276. No. 137 BROADWAY, N. Y.

NEW YORK, March 31, 1874.

The following prices are fixed for our Coal, delivered free on board vessels at the various shipping ports during the month of April

We reserve the right to change these prices at any time, except on contracts made prior to such change.

FOR GAS PURPOSES.

Youghiogheny Gas Coal, at South Amboy, N. J. (N. Y. AND CLEVELAND GAS COAL COMPANY'S MINES.)	**$7 00**	per ton of	2,240 lbs.
Joy (Sterling) Gas Coal, at Cleveland	**4 75**	per ton of	2,000 lbs.
Kanawha, W. Va., Cannel Coal, at Richmond (PEYTONA MINES)	**10 50**	per ton of	2,240 lbs.
at New York	**12 75**	"	"

FOR STEAM AND DOMESTIC USE.

BITUMINOUS.

Kanawha, W. Va., House Cannel, at Richmond	**12 00**	per ton of	2,240 lbs.
at New York	**14 25**	"	"
Crawford (Mount Carbon) at Buffalo			
Allegheny Orrel, at South Amboy	**8 00**	"	"

	Sugar Loaf Lehigh, at South Amboy	Hazelton Lehigh, at Elizabethport, N. J.	
ANTHRACITE.			
Lump	**$5 55**	**$5 40**	per ton of 2,240 lbs.
Broken	**5 50**	**5 35**	" "
Egg	**5 50**	**5 35**	" "
Stove	**5 65**	**5 50**	" "
Chestnut	**4 70**	**4 55**	" "
No. 2 Chestnut	**3 75**		

Special arrangements may be made with us for delivery at any point on the coasts of New York and New England, the Hudson River, Erie Canal and the Lakes. We invite special attention to our **Kanawha, W. Va. House Cannel, the Crawford (Mt. Carbon) and Allegheny Orrel.** They are unsurpassed for Parlor, Library, and Office uses, being entirely free from Sulphur and other impurities.

Our Eastern shipments are made from the Wyoming Pier, South Amboy, and Richmond, Va. Vessels going to either port for any other kind of cargo, may get one car load or upwards, as purchasers may desire, of selected Lump Coal for family use. Orders will be entered on our books as they are received, and shipments will be made in regular turn.

We are Agents for the Miners of our Gas and Bituminous Coals, and we sell at the lowest market cash prices.

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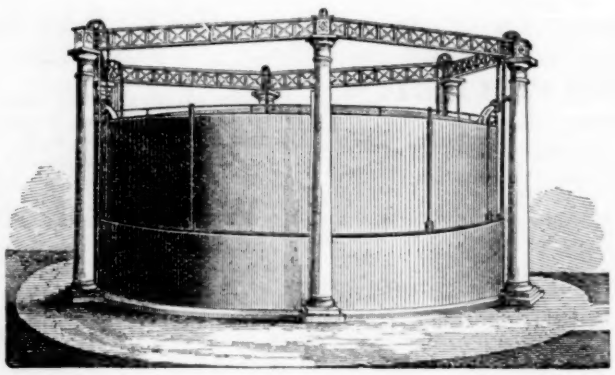

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Wrought Iron Work for Bridges, Buildings, Steam Boilers, Tanks, Stills, Etc.

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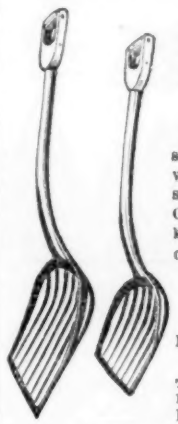

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FURNISHED WITH LONG OR D HANDLES

Perfect in their operation, a very strong, and from their great durability vastly more economical than any substitute. Refer to all the principal gas Companies in the country, who acknowledge them as the "ne plus ultra of Coke Screening Shovels.

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☞ I still retain the original Sabbaton Leiters Patent, and have granted no rights or privileges to any other parties.

THE CAMBRIDGE GAS-LIGHT CO.

Having erected new Works, offer for sale at a great reduction from cost, the following articles of apparatus:

Fourteen lengths of Hydraulic main, 16 inches diameter, 7 feet 7 inches long, 5 holes for dip pipes.
Seventy Dip Pipes, 5 inches diameter.
Seventy X Pipes, 5 inches diameter.
Seventy Stand Pipes, 6 to 5 inches diameter.
Seventy Mouth Pieces for 6 inch Stand Pipes.
One set Condensers, 14 inch Pipes with 6 in. internal Pipe.
One Exhauster with Compensator, Governor, Valves, Pass, by and Connecting Pipes, 8 inches diameter, made by Smith & Sayre, in use but a short time; capacity 12,000 feet per hour; has delivered 16,000 with ease; amply sufficient to deliver 350,000 feet a day.
Four Purifiers, 10 by 16 feet, 5 sets trays, 8 inch connections, all in perfect order except the covers.
Wet Centre Seal for the same.
Two sets Hoisting Gear for covers.
Also a Station Meter with 10 inch connections; made by Tufts; has been run but a short time, in perfect order Capacity 15,000 feet per hour.

Any part or the whole of the above will be sold very cheap, and delivered in six'y days.

Apply by letter or personally to Estes Howe, Treasurer, or William Gibson, Superintendent, at the office of the Company, Harvard Square, Cambridge, Mass. 343-tf

Portland Cement,
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Numbers 1 and 2.

From best London Manufacturers.

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76 South Street, New York,
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OFFER THEIR SUPERIOR

DESPARD COAL

To Gas Light Companies throughout the country.

Agents, PARMELEE BROTHERS, No. 32 Pine street, N. Y
BANGS & HORTON, No. 31 Duane street, Boston.
Mines in Harrison County, West Virginia.
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. Reference to them is requested 204-1y

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Letters in reference to Coal should be addressed to the General Office of FREEMAN BUTTS, Cleveland, Ohio. 354

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Thomas Gemmell, *President.*
A. Robinson, *Vice-President and Treasurer.*
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Mines at Wilsonburg, Harrison Co., W. Va. Shipping Port, Baltimore.

This coal yields of Gas 11,200 cubic feet per ton of 2,240 lbs. and has an Illuminating Power of 16.30 st. candles. 350-3m

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This coal yields 10,000 cubic feet of Gas, with an illuminating power of over 16 candles. Forty bushels of very superior Coke, with little Ash, and scarcely any clinker. 304-1y

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We offer special inducements to parties wishing to purchase. My Pipe is Smooth, regular in weights, and cast vertically.

N. B.—Pipe from 3-inch and upwards, cast in 12-ft. lengths.

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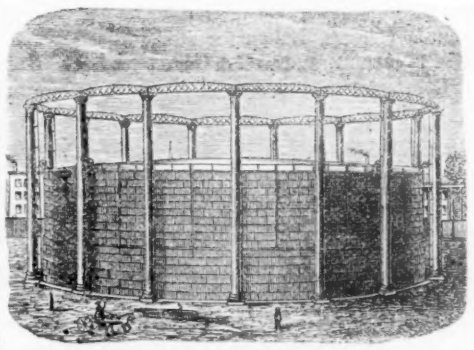

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And Fittings for Gas & Water Mains, &c.

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WILLIAM A. McINTOSH, President.
A. CARNEGIE, Vice-President.
W. P. DE ARMIT, Treasurer.
THOMAS AXWORTHY. Agent at Cleveland, Ohio.

351-1y

THE NEWBURGH

Orrel Coal Company,

Mines at Newburg, Preston County, W. Va.
Company's Office, No. 52 S. Gay Street, Baltimore, Md.
C. OLIVER O'DONNELL, Pres't. CHAS. MACKALL, Sec'y.
CHAS. W. HAYS, Agent in New York, Room 7, Trinity Building, 111 Broadway.
SINCLAIR & AGNEW, Agents, Alexandria, Va.

This Company offer their very superior Gas Coal at lowest market prices.

It yields 10,396 cubic feet of gas to the ton of 2,240 lbs. of good illuminating power, and of remarkable purity; one bushel of lime purifying 6,792 cubic feet, with a large amount of coke of good quality.

It has been for many years very extensively used by various Gas Companies in the United States, and we beg to refer to the Manhattan, Metropolitan, and New York Gas Light Companies of New York; the Brooklyn and Citizen's Gas Light Companies of Brooklyn, N. Y.; the Baltimore Gas Light Company of Baltimore, Md., and the Providence Gas Light Company, Providence, R. I.

The best dry coals shipped, and the promptest attention given to orders. 224-1y.

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OFFICE AND WORKS
938 to 954 River Street and 67 to 83 Vail Ave.,
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BRASS AND IRON SLIDE VALVES.

(Double and Single Gate ¼ inch to 36 inch—outside and inside screws, Indicator etc.) for Gas, Water and Steam.—.

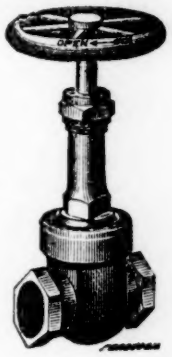
HYDRAULIC MAIN DIP REGULATORS.

ALSO

FIRE HYDRANTS.

REFERENCES FURNISHED.

SEND FOR CIRCULARS.



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Practical Builders,

And Contractors for the Erection of Gas Works,

MANUFACTURERS OF ALL THE LATEST AND MOST IMPROVED APPARATUS AND TOOLS FOR THE MANUFACTURE & DISTRIBUTION OF COAL GAS.

☞ WORKS AT THE RAILWAY DEPOTS,

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We manufacture Bench Castings, Washers, "The Immersed Multitubular," and Atmospheric Condensers, Wet and Dry-Lime Purifiers, Dry Center Seals, Telescopic and Single Gas Holders, Wrought Iron Trussed Roof for Iron or Slate, Wood and Iron Trays for Purifiers, Coke and Coal Carts, Wrought Iron Screening Shovels and Castings, and Wrought Work of every description for Gas-Works.

As Mr. Murray is a Practical Draughtsman, we will furnish plans and specifications to parties or associations, or will wait personally upon parties contemplating the construction of new works, or the alteration or extension of old ones

The most satisfactory references can be given, if required of the experience and commercial fairness which characterizes our dealings.

We would respectfully invite Western mento call and see our patterns and works here. MURRAY & BAKER,
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OFFICE OF THE

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No. 4 Warren Street, New York.

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Further information, and terms of sale of rights will be given, upon application to the Company. 348-1

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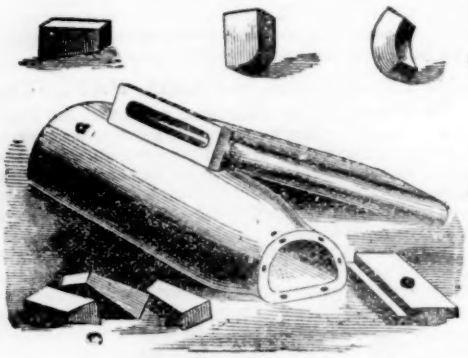

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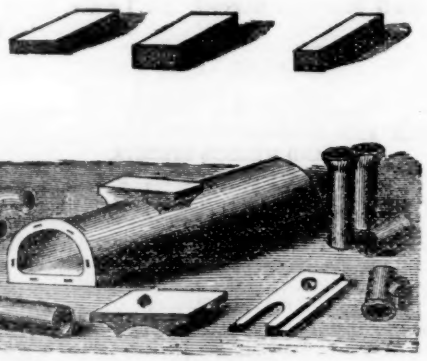

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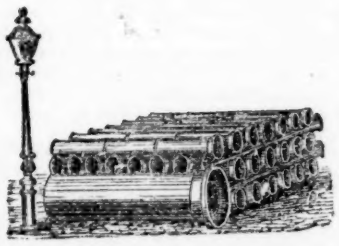

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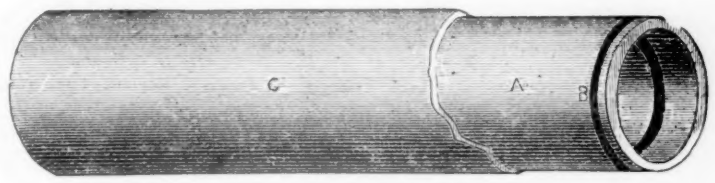

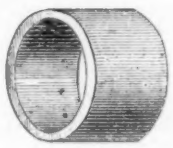

FIG. 2.

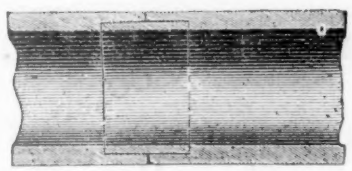

FIG. 3.

A—Cylinder of Wood. B—Band of Iron. C—Coating of Hydraulic or Asphaltum Cemen

FIG. 2.—Thimble for Connection. FIG. 3.—Horizontal Section and Connection.

Above is a cut of the

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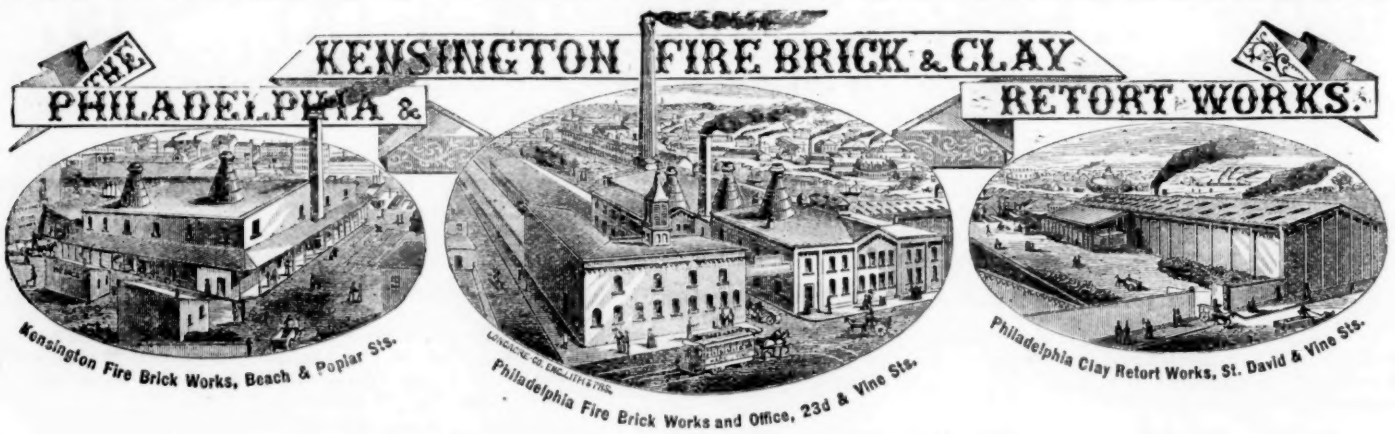
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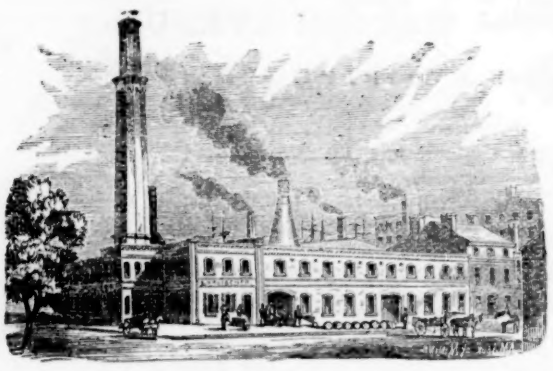

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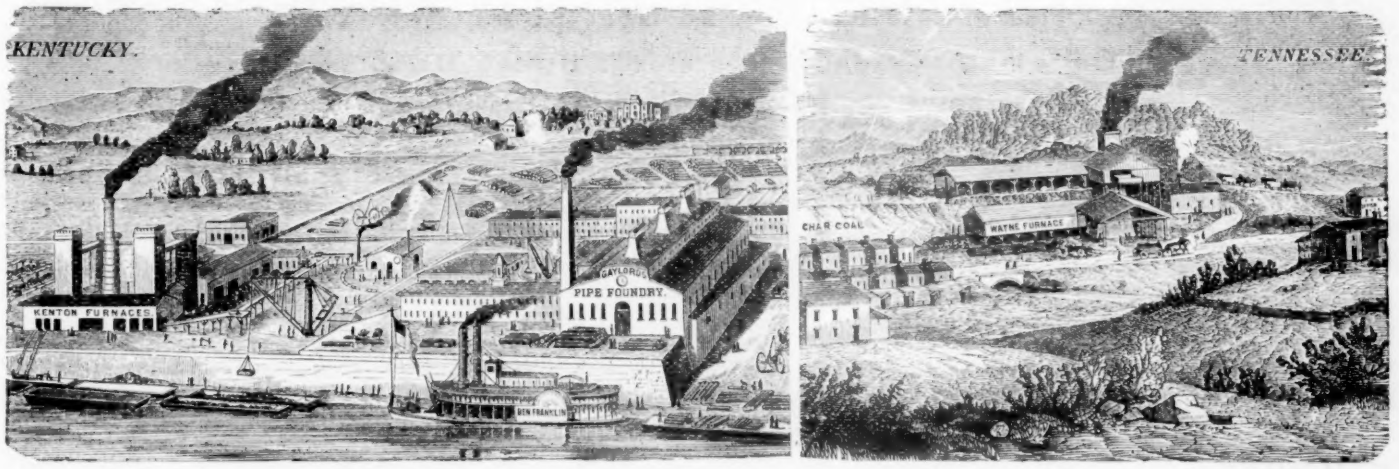

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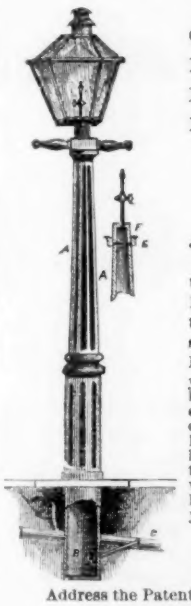

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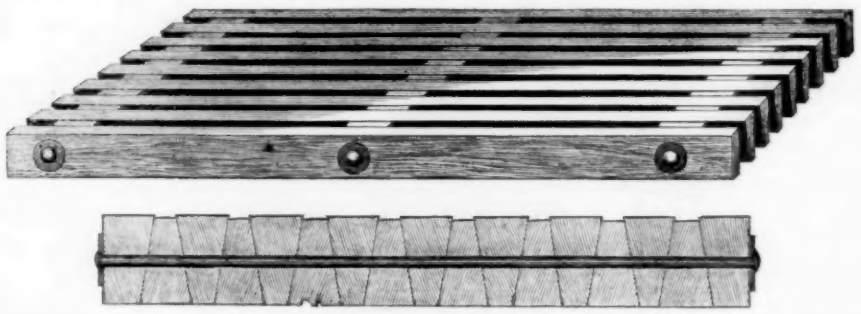

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Albany Gas-Light Company, N. Y.
Schenectady Gas Light Company, N. Y.
Utica Gas-Light Comwany, N. Y.
Jersey City Gas Company, N. J.
St. Paul Gas-Light Company, Minn.
Cumberland Gas-Light Company, Md.
Hartford City Gas-Light Company, Conn.
Richmond Gas Company, Va.
McKeesport Gas Company, Pa.
Middletown Gas Company, Pa.
East Newark Gas-Light Company, N. J.
Binghampton Gas Company, N. J.
Zanesville Gas Company, Ohio.

New Orleans Gas Company, La.
Salem Gas-Light Company, Mass.
New Britain Gas-Light Company, Conn.
Rahway Gas-Light Company, N. J.
Trenton Gas-Light Company, N. J.
Elmira Gas Company, New York.
Erie Gas Company, Pa.
Columbus Gas-Light Company, Ohio,
Westchester Gas-Light Company, N. Y.
Santa Cruz Gas Company, Cal.
Lawrence Gas-Light Company, Kansas.
Salem Gas Company, N. J.
Indiana Gas-Light Company, Pa.
Peoria Gas Company, Ill.
Montclair Gas Company, N. J.
Williamsport Gas Company, Pa.
Wooster Gas-Light Company, Ohio.

Augusta Gas-Light Company, Ga.
Huntsville Gas Company, Ga.
Chattanooga Gas Company Tenn.
Murfreesboro Gas Company, Tenn.
Hagerstown Gas-Light Company, Md.
Hanover Gas Company, Pa.
Easton Gas Company, Pa.
Uniontown Gas-Light Company, Pa.
Coatesville Gas-Light Company, Pa.
Houston, Gas Company, Texas.
Wilkesbarre Gas Company, La.
Middletown Gas Company, New York.
Washington Gas-Light Company, Pa.
Princeton Gas-Light Company, N. J
Newark Gas Company, Ohio.
Pontiac Gas-Light Company, Mich
And numerous other Companies.